CRITERIA TO BE USED IN DETERMINING PROJECT DURATION OF ROAD REHABILITATION PROJECTS IN SRI LANKA

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Abstract

Project duration is one of the critical features of a construction project which is determined by project planners during pre-tendering stages. Although there are several project forecasting techniques that are being practiced globally, in Sri Lanka it is the experience and practice that are used to determine the duration of a road rehabilitation project. Hence this research was aimed at developing criteria to determine the time of completion of road rehabilitation projects in Sri Lanka. Initially, a literature synthesis was carried out to identify project duration forecasting methods that are currently available and factors that can affect project durations. Subsequently, the extent of usage of those methods and factors, were determined through interviews. The main criteria were divided into four sub-criteria as relating to project scope, project complexity, project environment and management attributes. Based on the findings, 'Unrealistic contract durations imposed by the client' was found to be the most critical delay factor. Project scope related criteria were the most critical factors that could affect the duration of a road rehabilitation project in Sri Lanka. Thus, it is recommended to use proper methods or criteria to determine project durations of road rehabilitation projects in Sri Lanka.

Keywords: Project duration; Road rehabilitation projects; Project duration forecasting

1. Introduction

Today, the construction sector is a significant contributor to the rapid growth of the economies that are developing (Sawhney, Agnihotri, and Paul, 2014). Construction has three sectors in general, namely buildings; infrastructure and industrial (Ling, 2003). Roadways which belong to the infrastructure sector make a significant contribution to the growth of the economy of a country (Burningham and Stankevich, 2005). Many road construction projects in Sri Lanka, experience long delays and as a result, the economy of the country gets affected in several ways (Pathiranage, 2011).

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Due to the increasing number of projects in the construction field and their complexity, it has become very essential for those involved in managing these projects to have knowledge on project management, methods and standards (Aliverdi, Naeni, and Salehipour, 2013). Professionals in the industry also have developed several models to help keep a project as planned without any cost or time over runs. These models are useful in forecasting work zone durations (Irfan et al., 2011). Majid and McCaffer (as cited in Irfan et al., 2011) have stated that a knowledge of the expected project duration can help in determining delay costs and the safety associated with a project.

According to Khosrowshahi (1997), political changes and cultural issues can make the economy of a country to lead to time overruns of its projects. Seventy six per cent (76%) of the contractors have indicated that the average time overrun of a project is between 10% and 30% of the original duration. About 56% of the consultants have also confirmed this percentage (Chan and Kumaraswamy, 1997). Perera (2006) has stated that among road construction projects in Sri Lanka; at least 80% have faced the threat of time and cost overruns which is not surprising. As observed by Pathiranage (2011), local road construction projects experience at least 56% - 88% of time overruns on the average, in relation to the originally planned project duration. In building construction, modes of modelling and the prediction of construction durations of projects have been investigated by various researchers during the last four decades (Dursun and Stoy, 2012). Hegazy and Ayed (1998) have developed a model to estimate the road construction cost by considering the physical features of the relevant project. Many studies done in the past have identified factors that can cause delays in road construction projects, but the criteria and a systemic approach for determining the duration of road rehabilitation projects are not available in Sri Lanka.

1.1. AIM
The aim of this research is to develop criteria that can be used to determine the time of completion of road rehabilitation projects in Sri Lanka.

1.2. OBJECTIVES
The objectives of this research are as follows:

- To identify the most significant reasons that causes delays in construction projects
- To identify the methods used currently to determine the time of completion of a project
- To identify the current usage of the methods used in Sri Lanka
- To identify reasons for not using scientific methods to determine the time of completion of projects
- To identify criteria that will help to determine project durations

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- To rank the criteria that will help to determine the time of completion of projects

This paper commences with a review of literature on duration forecasting techniques and reasons for delays in the construction industry. The subsequent section presents the research methodology followed by a section presenting the findings of the study. The final section presents the conclusions and recommendations.

2. Literature Synthesis

A detailed literature synthesis was carried out to identify the causes of delays in road projects, project duration forecasting techniques and factors affecting project duration.

2.1. REASONS FOR DELAYS IN ROAD PROJECTS

A construction duration will consist of two parts (Kaliba et al., 2009), namely contract time and delay. In construction, a delay could be expressed as the time overrun which can be either ahead of the completion date denoted in a contract, or ahead of the date that the parties had consented for the deliverance of the project (Assaf and Al-Hejji, 2006). Due to higher overhead, material and labour costs caused by inflation, project delays nowadays have become a common subject in the international construction industry (Goodrum, Wan, and Fenouil, 2009). Barrie and Paulson (1992) have categorised the causes of delays into four groups as changed conditions and change orders; extra works; owner or his/her agent; and third party contractors. Throughout the literature review 32 reasons were identified and these reasons have been professed under the sub topic 4.1. On the other hand, a project duration accurately forecasted will help to avoid delays.

2.2. PROJECT DURATION FORECASTING TECHNIQUES

Forecasting of the construction duration of a project which can be achieved by many means will depend on the stage at which the construction is planned (Kawakye 1997). Predicting project performance is very essential in tracking and controlling a construction project (Pewdum, Rujirayanyong, and Sooksatra, 2009). According to Kim (2007), a critical component of project management is the forecasting of the project duration. Several forecasting methods have already been proposed based on earned value technique, fuzzy logic, social judgment theory and neural network (Wichan et al., 2009). The BTC model, ANN model, Earned Value Method, Fuzzy Logic and Simulation Model are some of these methods. It is also essential at this stage, to ascertain the factors that will assist in forecasting project duration.

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2.3. FACTORS AFFECTING PROJECT DURATION

In order to predict project duration accurately, certain factors such as construction cost, contract procurement, site conditions, buildability of the design, quality management etc., need to be considered. These factors can be divided into four sections (Chan and Kumaraswamy, 2002) as indicated below.

- Project Scope
- Project Complexity
- Project Environment
- Management Attributes

Pathiranage (2011) has explained that many road construction projects experience long delays and that as a result, the economy of the country gets affected considerably. According to Dursun and Stoy, 2012, construction duration is a significant factor that gives rise to complex scenarios in the construction industry in numerous ways. Therefore a necessity has been aroused to identify the significant factors which affect to predict the project duration accurately in order to avoid unnecessary delays caused due to errors in calculating project duration. The factors affecting the project duration which were identified through literature have been further discussed under findings.

3. Research Methodology

An extensive literature survey was carried out to identify the methods that are used currently to determine project durations. In order to validate the findings of the literature survey, preliminary interviews were conducted with three industry experts employed in the road sector. One interviewee was from a contractor organization with 23 years of experience while the other two were from consultancy organizations with 15 and 21 years of experience respectively. The software program NVivo 10 offered by QSR (Qualitative Solutions and Research Ltd.) was used to analyse the findings of the preliminary interview. A detailed questionnaire survey was carried out among professionals working in the construction industry in Sri Lanka to identify the basis on which the time of completion of a project is currently determined. The data so collected was analysed using statistical analysis tools, RII and AHP (Analytical Hierarchical Process).

4. Research Findings

The research findings of the preliminary interviews and the detailed questionnaire survey helped to develop criteria that can be used in determining the time of completion of construction projects, causes for delays in construction projects and the reasons for not using scientific methods to determine project durations.

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4.1.SIGNIFICANT CAUSES OF DELAYS IN CONSTRUCTION PROJECTS

The causes for delays in construction projects identified through the literature review were ranked through the questionnaire survey to identify their degree of significance. The data collected through the questionnaire survey was analysed using RII to achieve this purpose. The data analysis indicated that "Unrealistic contract durations imposed by the client (unrealistic time allocation)" was the most critical reason for delays in construction projects with a RII value of 0.90. Fifty eights percent (58%) of the respondents ranked this reason as "very highly critical".

The causes for delays in construction projects thus can be ranked as follows:

1. Unrealistic contract durations imposed by the client (unrealistic time allocation)
2. Land acquisition
3. Inadequate contractor experience
4. Shortage of skilled labour
5. Delays in subcontractors' work
6. Environmental problems
7. Low speed of decision making among project teams
8. Contractors' deficiencies in planning and scheduling during preconstruction stage
9. Changes in the design and scope
10. Political interference
11. Poor site management and supervision
12. Inadequate managerial skills
13. Shortage of managerial and supervisory personnel
14. Project construction complexity
15. Shortage of materials
16. Imprecise contract clauses and late payments
17. Financial problems
18. Delays in making decisions and getting approval by the owner
19. Improper design
20. Poor financial management
21. Improper control over site resource allocation
22. Unforeseen ground conditions
23. Required variations of works
24. Lack of communication between the consultant and the contractor
25. Client-initiated variations
26. Lack of communication between the client and the contractor
27. Poor procurement programming of materials
28. Low labour productivity
29. Low speed of decision making within each project team

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30. Poor preliminary planning
31. Difficulties in obtaining work permits
32. Coordination and communication problems

4.2. PROJECT DURATION FORECASTING TECHNIQUES

From the literature review, various project duration forecasting techniques such as BTC model, ANN model, Earned Value Method, Fuzzy Logic and Simulation Model were identified. According to the findings of the interviews, the usage of these forecasting techniques in Sri Lanka was very rare for different reasons which will be discussed later. The Sri Lankan practice for determining project duration is to use a rule of thumb or prior experience.

4.3. REASONS FOR NOT USING A SCIENTIFIC METHOD TO DETERMINE THE DURATION OF A PROJECT

According to the interview results, no scientific method is used for determining project duration in the Sri Lankan industry. From the interviews, some of the reasons for not using a scientific method could be ascertained. During the questionnaire survey, those reasons were ranked in order to identify the most significant reason among them. The most significant reason for not using a scientific method was found to be "Knowledge level of the people" having a RII value of 0.70 followed by "Attitude of the people" which had a RII value of 0.683.

Table 1: Ranking of the Reasons for not using a Scientific Method to determine the Duration of a Project

Reasons for not using a Scientific Method to determine Project Duration	RII	Rank
Knowledge level of the people	0.700	**1**
Attitude of the people	0.683	**2**
Political issues	0.633	**3**
Traditions	0.616	**4**

The respondents of the questionnaire survey, however, expressed several other reasons for not using scientific methods in Sri Lanka for determining the time of completion of projects. They are as follows:

- As Sri Lanka is a third world country, Sri Lankans are always keen to first satisfy their personal requirements to gain industrial benefits.
- There is political influence when determining the durations of road projects.
- There is a practice to adopt ad-hoc methods based on experience.
- There is only a short documentation period.

- There is lack of transparency in the process.
- There are cultural issues specific to the country.
- In the construction industry, there is an absence of scientifically developed financial procedures.
- There is no proper forecasting method available to predict weather patterns and climatic conditions.
- Clients attempt to reduce the contract period by considering the views of the people in order to mitigate the impact of a project on the society especially when the project is located in urban areas.

4.4. CRITERIA THAT WILL DETERMINE THE TIME OF COMPLETION OF PROJECTS

From the literature survey, it was discovered that there are several factors that can affect the duration of a project. With the assistance of the interviewees, these factors were categorised into four main types as project scope related criteria, project complexity related criteria, project environment related criteria and management attribute related criteria. Table 2 depicts the findings of the literature review and the additional criteria identified through the preliminary interviews.

Table 2: Criteria to decide the duration of road rehabilitation projects

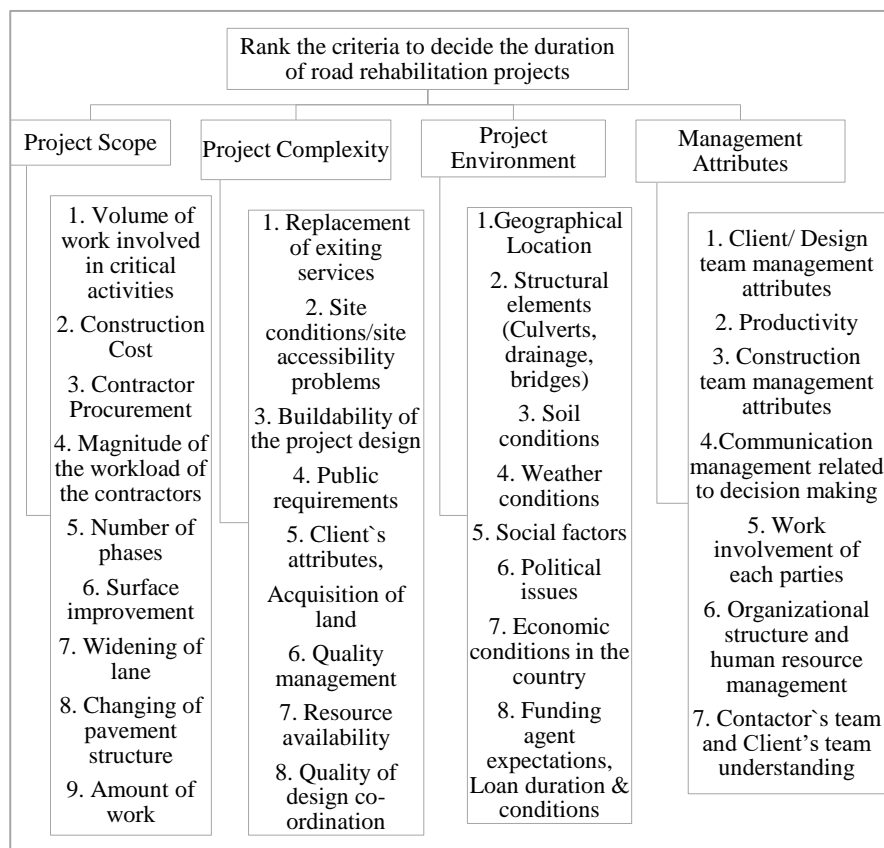|	**Literature findings**	**Added by interviewees**
Project scope related criteria	- Construction Cost - Contract Procurement - System variation	- Volume of the work in critical activities - Magnitude of the workload for the contractors - Number of phases - Surface improvement - Widening of lain - Changing Pavement structure - Amount of work
Project complexity related criteria	- Client`s attributes - Site conditions/site access problems - Build ability of project design - Quality of design co-ordination - Quality management	- Replacement of exiting services - Public requirement - Resources availability - Acquisition of land

Project environment related criteria	• Physical • Economical • Social-political • Industrial relations	• Geographical Location • Structural elements (Culverts, drainage, bridges) • Weather condition • Soil condition • Funding agent expectation, Loan duration & conditions • Economic condition in country
Management attributes related criteria	• Client/Design team management attributes • Construction team management attributes • Communication management for decision making • Organizational structure and human resources management • Productivity	• Work involvement in each parties • Contractor`s team and Client's team understanding

The questionnaire survey was used to identify the significance of each factor under each category. The data collected through the questionnaire survey was analysed using AHP hierarchy to rank the importance of the factors under each category. From this, the criteria to be used in determining the time of completion of projects could be identified. Figure 1 illustrates the AHP Hierarchy for the ranking criteria.

The findings revealed that the "Volume of work involved in critical activities" was the most significant factor among project scope related criteria. The most significant factor among project complexity related criteria was identified as the "Replacement of exiting services" whereas "Geographical location" was identified as the most significant factor among project environment related criteria. "Client/Design team management attributes" was identified as the most significant factor among management attribute related criteria. The validity of the collected data and their level of consistency were verified through consistency calculations. Through these mechanisms, a ranking method to determine the project duration of road rehabilitation projects in Sri Lanka was developed. The overall importance score was obtained using the AHP process and multiplying the importance score of each sub criteria by its importance

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Rank the criteria to decide the duration of road rehabilitation projects			
Project Scope	**Project Complexity**	**Project Environment**	**Management Attributes**
1. Volume of work involved in critical activities	1. Replacement of exiting services	1.Geographical Location	1. Client/ Design team management attributes
2. Construction Cost	2. Site conditions/site accessibility problems	2. Structural elements (Culverts, drainage, bridges)	2. Productivity
3. Contractor Procurement	3. Buildability of the project design	3. Soil conditions	3. Construction team management attributes
4. Magnitude of the workload of the contractors	4. Public requirements	4. Weather conditions	4.Communication management related to decision making
5. Number of phases	5. Client`s attributes, Acquisition of land	5. Social factors	5. Work involvement of each parties
6. Surface improvement	6. Quality management	6. Political issues	6. Organizational structure and human resource management
7. Widening of lane	7. Resource availability	7. Economic conditions in the country	7. Contactor`s team and Client's team understanding
8. Changing of pavement structure	8. Quality of design co-ordination	8. Funding agent expectations, Loan duration & conditions	
9. Amount of work			

Figure 1, AHP Hierarchy for the Ranking Criteria

score. Figure 2 illustrates the criteria identified as helping to determine the time of completion of projects.

The "Number of phases" was found to be the most critical factor to be considered in determining the time of completion of construction projects in Sri Lanka followed by "Volume of work involved in critical activities" and "Contractor Procurement".

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Criteria to decide the time for completion

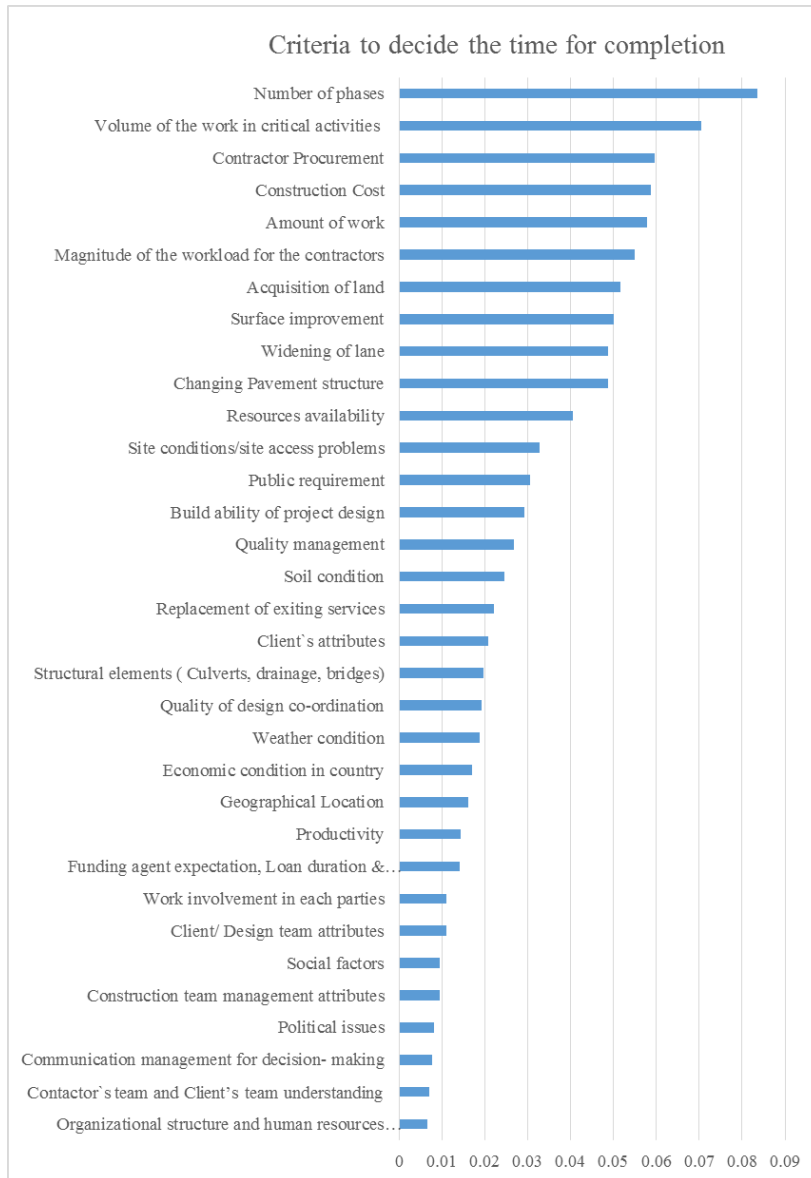| Criteria	Score
Number of phases	0.084
Volume of the work in critical activities	0.070
Contractor Procurement	0.060
Construction Cost	0.059
Amount of work	0.058
Magnitude of the workload for the contractors	0.055
Acquisition of land	0.052
Surface improvement	0.050
Widening of lane	0.049
Changing Pavement structure	0.049
Resources availability	0.040
Site conditions/site access problems	0.033
Public requirement	0.030
Build ability of project design	0.029
Quality management	0.027
Soil condition	0.025
Replacement of exiting services	0.022
Client`s attributes	0.021
Structural elements (Culverts, drainage, bridges)	0.020
Quality of design co-ordination	0.020
Weather condition	0.019
Economic condition in country	0.018
Geographical Location	0.017
Productivity	0.015
Funding agent expectation, Loan duration &…	0.015
Work involvement in each parties	0.011
Client/ Design team attributes	0.011
Social factors	0.010
Construction team management attributes	0.010
Political issues	0.009
Communication management for decision- making	0.008
Contactor`s team and Client's team understanding	0.007
Organizational structure and human resources…	0.007

Figure 2, Graphical Illustration of the Criteria Ranking according to the Overall Importance Score

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4. Conclusions and Recommendations

The findings demonstrated that "Unrealistic time duration" was the most
critical factor that causes delays in construction projects. It can therefore be
concluded that the determination of a realistic time duration was the most
important solution for mitigating project delays. On the other hand, it is
essential to use a project duration forecasting technique such as the BTC
model, ANN model, Earned Value Method, Fuzzy Logic or the Simulation
Model. However in road construction projects in Sri Lanka, instead of using a
scientific project duration forecasting technique, a rule of thumb or prior
experience is used to determine project duration.

It is necessary to consider the ranking of the criteria that affect project duration
to formulate recommendations that will help to manage project durations of
road rehabilitation projects in Sri Lanka. Initially, it is recommended to pay
attention to the most critical factor, project scope related criteria. Thereafter,
project complexity related criteria followed by project environment related
criteria have to be considered. Finally, management attribute related criteria
have to be considered in deciding the project duration.

It is recommended that knowledge of the relevant parties on realistic
forecasting of time durations should be enhanced by responsible professionals
working in the local construction industry. As the government is also involved
with the road sector, it will also be its responsibility to see that political
influence is mitigated and that there is an established independent decision
making process for determining project durations. These steps will help to
mitigate delays in projects and enable the projects to be successful as far as
their costs and time are concerned.

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